



THE USE OF BLOCKCHAIN TECHNOLOGY FOR SECURE AND TRANSPARENT MEDICAL RECORD MANAGEMENT

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Abstract

Electronic health records (EHRs) are crucial documents that provide comprehensive health information, but they are susceptible to security breaches, power outages, and unauthorized access. Blockchain technology offers a decentralized platform for sharing EHR data, enhancing security and decentralization. Blockchain is particularly useful for smart contracts and machine-learning algorithms. However, it faces challenges in scalability and complexity. To address these issues, integrating artificial intelligence and blockchain technology can be beneficial. AI algorithms rely on data from reliable, trustworthy, and reputable platforms for learning and decision-making. A systematic literature review (SLR) was conducted on 189 research articles on EHR management using blockchain technology, focusing on security, confidentiality, access, and sustainability. The SLR found that blockchain technology offers decentralization, security, and privacy, which are often lacking in traditional EHRs. The findings provide valuable insights for future researchers on the best choice of blockchain technology for their studies. The SLR also provides a comprehensive analysis of various healthcare approaches and their advantages and disadvantages. The integration of blockchain and AI in health records management systems allows for the exploration of potential uses.

Keywords: blockchain, artificial intelligence, algorithms, literature review, electronic health records.

1. Introduction

Medical and healthcare researchers stress the significance of their capacity to gather and analyze data from multiple sources to detect potential health risks in communities, offer tailored treatments, and administer targeted medicine [1]. This ability can enhance informed clinical decision-making and ultimately enhance the quality of patient care. This data may enhance the functionality of personal health information systems, such as patient health records (PHR) and



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patient portals. Patients often lack convenient access to their past data, while professionals maintain primary ownership.

The key to success lies in integrating blockchain, AI, and other easily accessible technology into a business's fundamental structure. In order to improve medical research and prioritize the requirements of patients, the industry must use technology to create interfaces that are focused on users and customers. Additionally, data-driven choices should be made to optimize data processing and achieve better results [2], [16]. Artificial intelligence (AI) might be used to discover and prioritize patients for medication monitoring and development, a crucial aspect of controlled drug manufacture and expedited timeframes [3]. The clinical trial data was analyzed using numerical drug design approaches and AI to assess the potential of repurposing commercial medications, investigate the effectiveness of prescription formulations, and determine optimal dosage [6].

Blockchain enables the creation and management of content blocks called ledgers, which include secure and automated data analysis. Health-related data will be securely captured and analyzed, enabling quick updates for doctors, healthcare providers, and payers. Storing extensive documents on the blockchain, including comprehensive electronic medical records or genetic data records, would be very inefficient and costly owing to the substantial processing resources needed. One significant limitation of blockchain technology is that it hinders the process of retrieving data from inside a blockchain. Integrating artificial intelligence algorithms onto the blockchain may effectively address this limitation [6]. In order to understand health trends and patterns, artificial intelligence has started to acquire knowledge and engage in logical thinking similar to that of a physician.

The system gathers unorganized data from several sources, such as the patient, the radiologist, and the images. AI has the ability to do intricate computational tasks and analyze large amounts of medical data quickly. Nevertheless, several physicians remain cautious about using AI in healthcare, especially in roles that might impact a patient's well-being, owing to the considerable skills that AI has, which have shown its ability to do various complex and cognitive tasks more rapidly than a human. The automotive industry has already proven its ability to use artificial intelligence (AI) in manufacturing self-driving vehicles. Nevertheless, several enterprises have already recognized machine learning algorithms as effective tools for detecting fraudulent activities and identifying potential financial risks, hence showcasing the advanced stage of artificial intelligence [17].

2. Rationale for Utilizing Blockchain Technology in Electronic Health Record (EHR) System

Electronic Health Records (EHRs) often include data such as a patient's medical history, personal demographics (such as age and weight), laboratory test results, and other relevant information. Consequently, it is essential to ensure the security and privacy of this data. In addition, hospitals in some nations such as the United States [13] are closely monitored by the

government to ensure compliance with tight regulations. The deployment and implementation of healthcare systems in practice can pose many challenges. As stated before, centralized server architectures are vulnerable to single-point attack limitations and malicious insider attacks. Users, such as patients, who have their data outsourced or kept in these EHR systems, relinquish control of their data. They lack the capability to determine the identity of those who are accessing it and the specific reasons behind their actions (e.g., potential infringement on personal privacy). Additionally, there is a risk that this information might be unlawfully disclosed to another entity by someone with malevolent intent. For instance, a patient's leaked medical data could lead to an insurance company denying treatment.

Meanwhile, the significance of data sharing is increasing, particularly as our society and people grow more mobile. Utilizing the interconnection of various healthcare companies, shared data has the potential to enhance medical service delivery. Overcoming the "Information and Resource Island" (information silo) will provide a challenge, mostly owing to privacy concerns and limits. Furthermore, the presence of an information silo leads to avoidable duplication of data and an increase in bureaucratic processes.

3. Advantages of Utilizing Blockchain and Artificial Intelligence

The coronavirus pandemic may be addressed via the use of blockchain technology and artificial intelligence (AI) in several ways. The blockchain has several practical applications that may be effectively used in combating the coronavirus pandemic. Blockchain technology has the potential to track the global spread of coronavirus infections by implementing blockchain network client software on mobile devices of consumers. A key feature of blockchain is its capacity to safeguard user privacy, enabling prompt detection of outbreaks while preventing the disclosure of user data. Additionally, it enhances epidemic and treatment management via the optimization of vaccination trials, ensuring efficiency and transparency. It also facilitates the monitoring of all fundraising efforts and contributions.

AI offers a variety of strategies to aid in the fight against the Coronavirus. Artificial intelligence (AI) may be used to detect viruses and predict their spread by collecting data on environmental variables [5], healthcare availability, and transmission methods. Through the process of categorizing the coronavirus inside specific instances of illness, artificial intelligence may assist in determining its presence with accuracy. Pneumonia, severe acute respiratory syndrome, and renal failure are potential consequences of coronavirus infections. An existing genome-based neural network designed for personalized care can be highly beneficial in managing the adverse events or symptoms resulting from a coronavirus. This is especially true when the impact of the virus is influenced by an individual's immunity and genome structure, and when no single treatment can effectively address all symptoms currently. Artificial intelligence (AI) may also expedite the process of developing a new vaccine for emerging coronaviruses [6].

As a culmination of AI advancements, it would be feasible to create an automated system that establishes a direct relationship or connection between medical information and outcomes. The rapid identification of diagnostic and treatment options provided by these models might be advantageous for clinical procedures designed for epidemics similar to the coronavirus. The White House has recently made a request to use artificial intelligence (AI) in order to aid the US government's response to the coronavirus epidemic. This request is motivated by the potential benefits that AI may provide.

Disintermediation refers to the state in which there is no central authority responsible for gathering, analyzing, and verifying data and models that are created and distributed. It facilitates the decrease in the duration, mistakes, and expenses of process performance with the goal of constructing and revising a predictive model that assists in clinical practice and risk management. The transactions validated by the blockchain and the data included in them are permanent and cannot be altered or deleted, guaranteeing their authenticity and enhancing the security of the system in which the activities occur [9]. In addition, the cryptographic system, the inability to change the data sent across the network, and the absence of a central authority promote increased trust in the system, since the need to maintain this trust among the parties involved diminishes [10-14].

4. Limitations of Healthcare Systems

Following the COVID-19 epidemic, there has been a critical examination of existing healthcare systems. Presently, several healthcare systems may be overwhelmed by the COVID-19 pandemic. Currently, there is a lack of a reliable data monitoring system [15-18] that can provide essential healthcare institutions with real-time information on prospective epidemics. Currently, the majority of information on the coronavirus is derived from many sources, including the general public, hospitals, and clinical laboratories. Unfortunately, a significant portion of this data is unreliable and lacks adequate monitoring. The use of untrustworthy data poses a significant obstacle to the detection and isolation of future outbreaks. Another constraint is the present time-consuming and imprecise process for detecting the coronavirus, which often requires several hours to complete the virus testing. This is deemed undesirable given the fast dissemination of the coronavirus.

Acquiring the skill to rapidly and precisely identify coronaviruses is of utmost importance. Processing coronavirus data using human-dependent medical software is very challenging, particularly when dealing with intricate patterns and large quantities. Blockchain technology provides robust security solutions to assist in combating pandemics. Undoubtedly, the blockchain generates unchangeable transaction ledgers for systems that share medical data. Significantly, the integration of blockchain with smart contract technology obviates the need for central servers to guarantee equity among transaction participants. Blockchain has two fundamental characteristics, namely traceability and decentralization, which distinguish it from

conventional security methods. Moreover, blockchain has the capability to provide dependable data analytics.

Data collecting is a crucial stage in disease analytics. Ensuring the dependability of obtained data is crucial for maintaining high-quality disease data analytics [19-22]. Utilizing inaccurate data or unreliable database sources might result in biased analytical findings, perhaps leading to severe outcomes, such as inaccurate medical diagnoses. In addition, during a crisis involving the spread of a contagious illness, several sources of disease data are gathered without adequate safeguards from hospitals, the general population, or the media, which may lead to alterations in the data. These concerns would undeniably impact the precision of the gathered data, diminishing the dependability of the analysis procedure. Blockchain is highly sought after in many situations because to its robust security, which guarantees the integrity of recorded data. Consensus mechanisms in blockchain guarantee the accurate sequencing of data records from sources to destinations, such as hospitals or clinical laboratories, thereby assuring the integrity of data collecting. The inclusion of these blockchain elements will guarantee precise data capture, hence ensuring dependable illness analysis [23,24].

5. Electronic Medical Records (EMRs) and Data Management

Various pilot programs worldwide have started the examination of the use of blockchain technology in healthcare facilities, and a number of these initiatives are now in progress. Booz Allen Hamilton Consulting, after successfully creating and introducing a pilot platform based on blockchain technology in the United States last year, was assigned the responsibility of providing guidance to the Food and Drug Administration's Office of Translational Sciences on the use of this technology in healthcare data management (Figure 1). The Ethereum Foundation is now overseeing a pilot project at four major hospitals. This initiative utilizes Ethereum to control data access using virtual private networks. By employing IPFS, the project is able to apply encryption and reduce data duplication. This is achieved by using off-chain cloud components and cryptographic approaches to simplify user sharing [19].

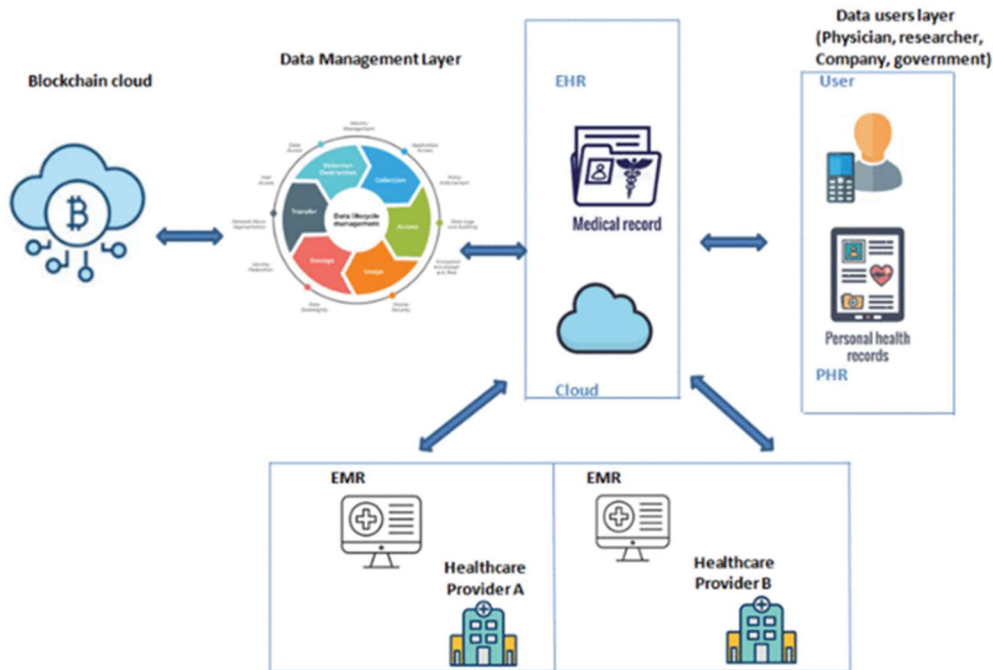


Figure 1. Structure of blockchain technology for hospitals.

6. Conclusion

Blockchain software is generating significant attention from individuals and organizations across many sectors and scales. By incorporating qualities like as decentralization, anonymity, permanence, and auditability, it has the ability to revolutionize the traditional industry. Artificial intelligence approaches are anticipated to be used in blockchain applications to transform the healthcare landscape. The process would not only be transparent and secure, but it would also enhance the quality of healthcare while reducing costs. In the suggested framework, we examined several blockchain technologies used in the healthcare business. We also highlighted the primary research topics and prospective opportunities for further investigation. Specifically, we deliberated on a suggested framework for the administration of health data and the potential of blockchain technology to empower patients and enhance the efficiency of exchanging health data.

Researchers widely agree that blockchain technology will enable patients to have true ownership and control over their own data. The blockchain enables the process of timestamping health records, ensuring that once they become part of the distributed ledger, they cannot be altered or tampered with. Patients own the prerogative to ascertain the individuals and the rationale for granting or denying access to their data.

In the 21st century, healthcare systems will include various technologies to establish a connection between patients and their providers. These technologies may include remote healthcare facilities and wearable gadgets, among others. These systems generate data constantly and are vulnerable to malicious assaults during transmission across many layers of the

communication network. This article discusses many research projects that propose the use of tamper-resistant systems, including blockchain technology and AI methodologies, to guarantee the integrity of health data.

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